

A 21st Century Approach to Reliability

Electrical Engineering

Mark Law, Aristotle, Ebers, Fellow

Toshi Nishida

Scott Thompson, SEMI Technology, Fellow

Gijs Bosman

Materials Science

Steve Pearton – Ebers, Bardeen, Fellow

Cammy Abernathy - Fellow

Brent Gila

Kevin Jones - Fellow

Chemical Engineering

Fan Ren - Fellow

Post-Docs

Michelle Griglione, Erin Patrick

Nick Rudawski, Robert Dieme

Current Students

David Cheney, Amit Gupta,

David Horton, Ray Holzworth

Patrick Whiting, Varun Khandelwal

Weikai Xu, Liu Lu

Students Graduated

Erica Douglas, Andy Koehler

Nicole Rowsey, Hemant Rao,

Min Chu, Mehmet Baykan,

Chien Fong Lo



Agenda

- 9:00 to 9:15 Overview - Law
- 9:15 to 9:45 Degradation Studies - Ren and Pearton
- 9:45 to 10:20 Optical Testing - Gila and Abernathy
- 10:20 to 10:45 Materials Characterization - Jones
- 10:45 to 11:00 Break
- 11:00 to 11:30 Noise and Degradation - Bosman
- 11:30 to 12:00 Gate Current and Strain - Nishida and Thompson
- 12:00 to 12:30 Simulation - Law
- 12:30 to 1:00 Discussion, Feedback

Presentations at:
www.reliability.ece.ufl.edu

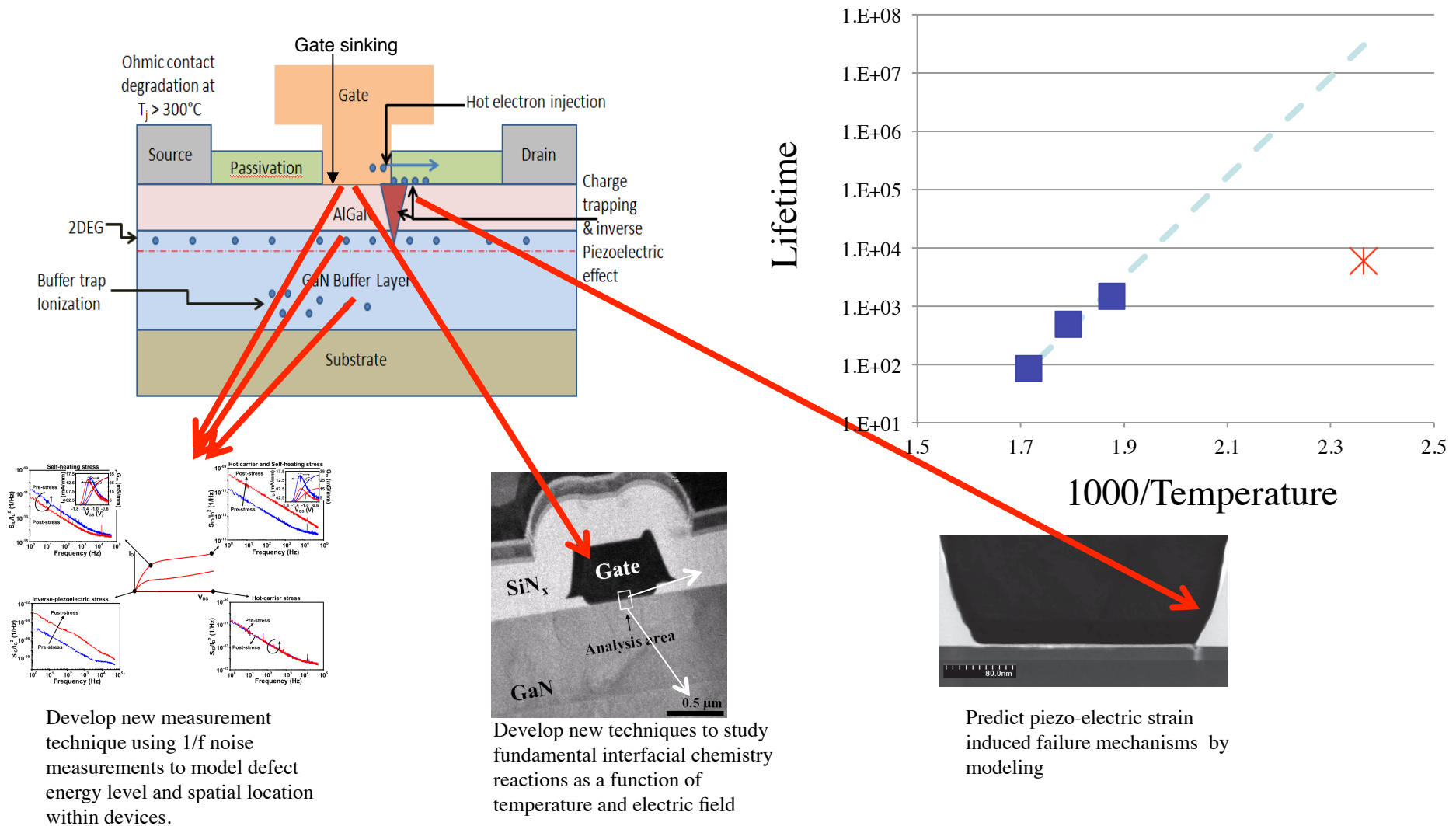
Precompetitive Engineering Scientific Research Focus

- Scientific Understanding of Materials Properties
- Understanding of Electrical Signatures
- Modeling / Simulation of Failure

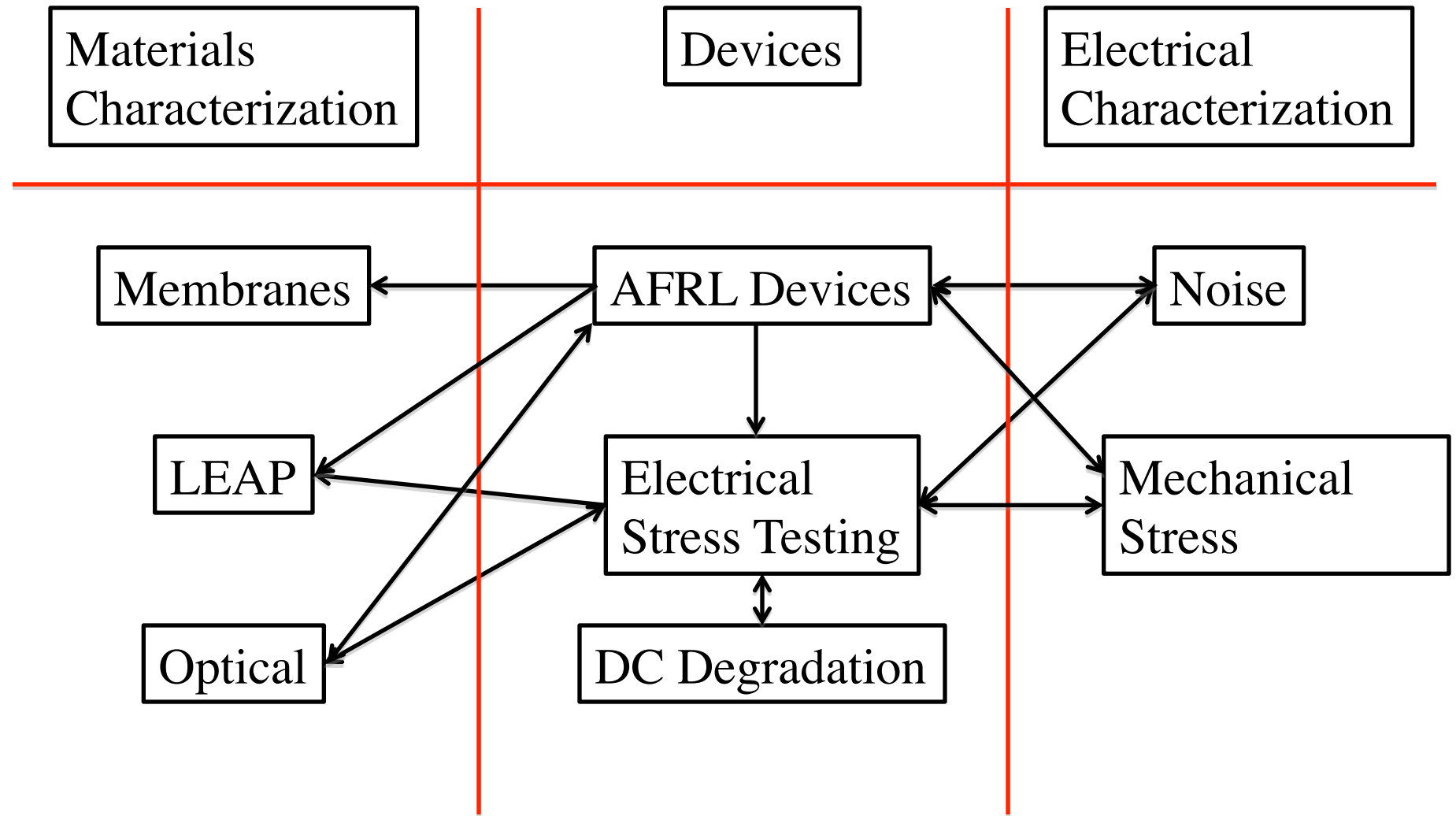
- Black' s Equation Empirically Captured Aluminum Electromigration in 1969
- Subsequent work on
 - Characterization of field, current density, temperature dependence
 - Characterization of mechanical stress
 - Characterization of grain size diffusion along grain boundaries
 - Characterization of etch effects related to grain size
 - Full 3-Dimensional Grain Models

Recent Papers in 2008 and 2009 - 40 years of science based pubs

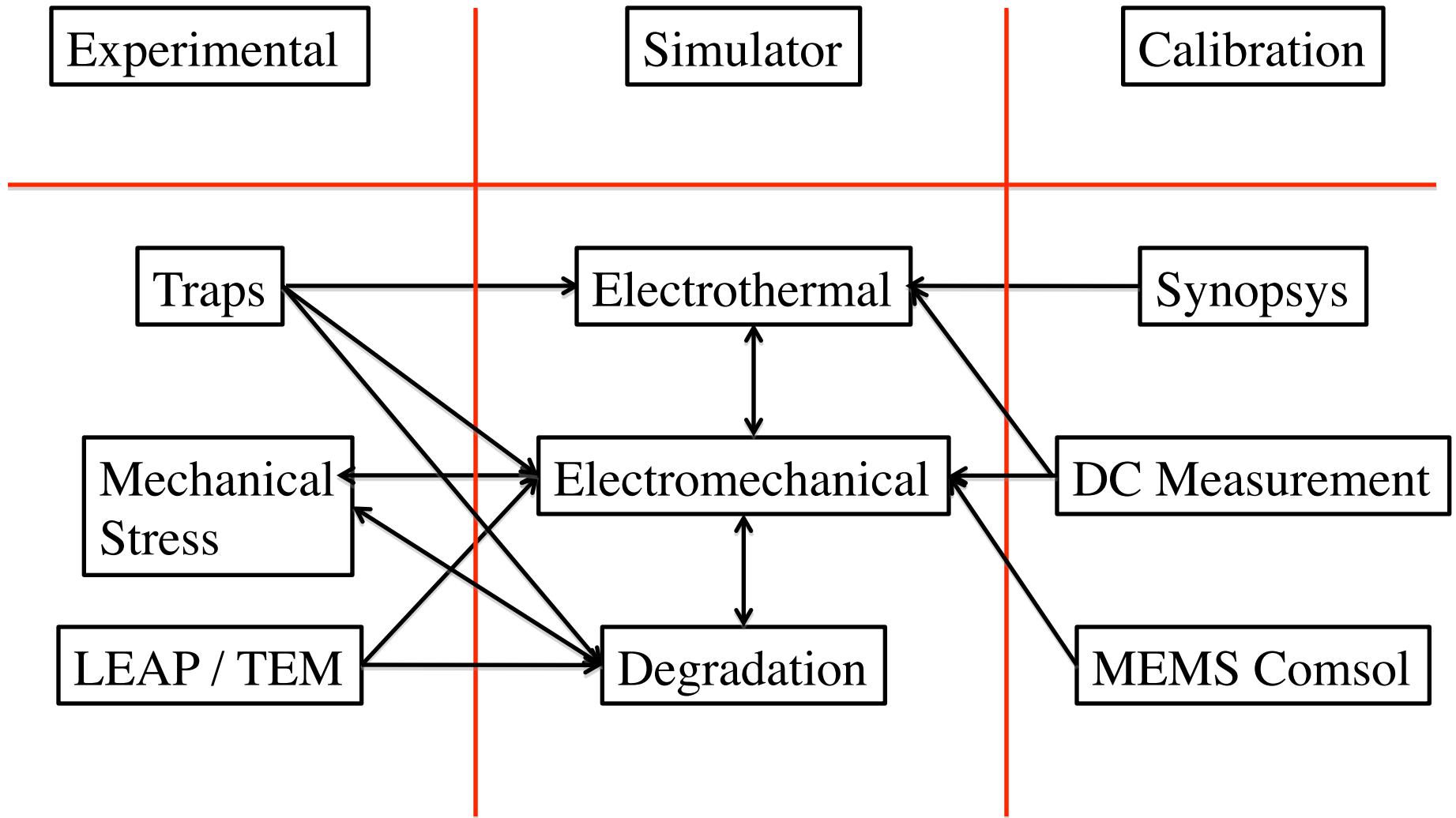
Understanding Device Degradation Physics



Device and Material Flow

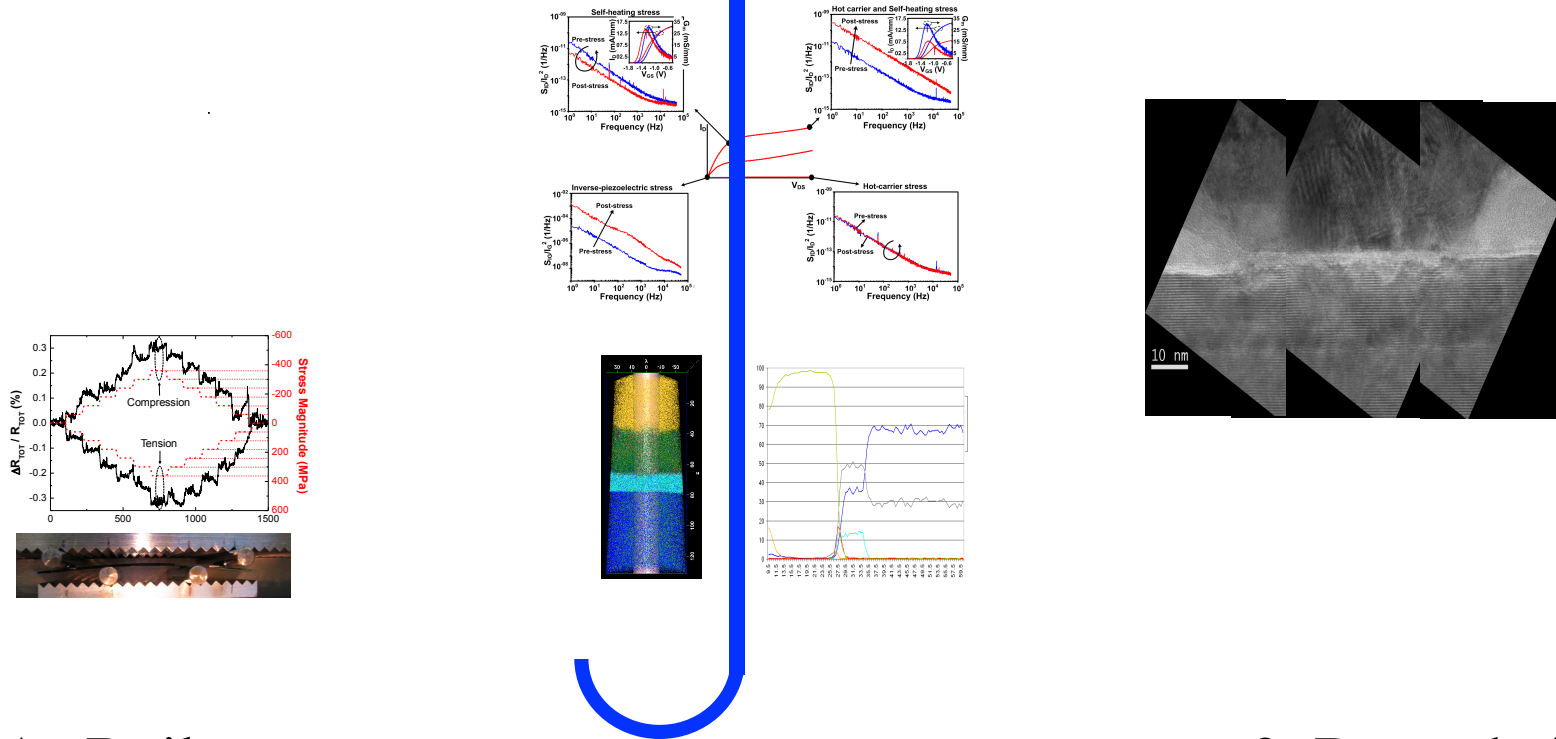


Theory Flow



Scientific Approach

FLOORS



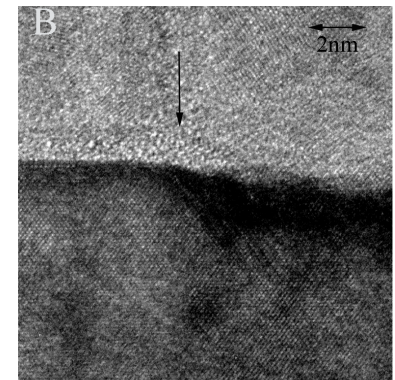
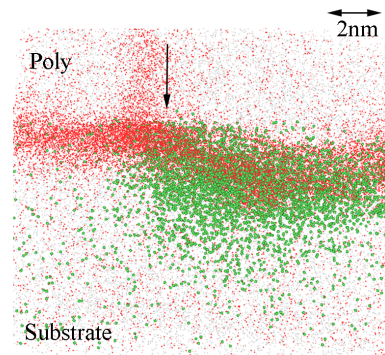
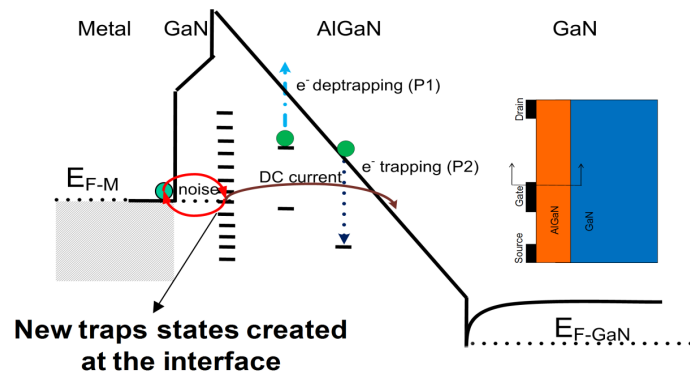
$t=0$, As Built

$t>0$, Degradation

Goals

FLOORS

Integrated Electrical, Thermal, Mechanical Simulation



Defect Location and Generation
Driven by Field, Mechanics, Thermal

Material Reaction / Interdiffusion
Driven by Field, Mechanics, Thermal

Unify previous techniques and combine with FLOORS to gain
and applicability of physics of failure.